Virginia Conservation Lands Needs Assessment

Setting Priorities for Land Conservation

DCR
Department of Conservation & Recreation
CONSERVING VIRGINIA'S NATURAL & RECREATIONAL RESOURCES
Virginia Natural Heritage Program

DCR mission

The Department of Conservation and Recreation works with Virginians to conserve, protect, and enhance their lands and improve the quality of the Chesapeake Bay and our rivers and streams, promotes the stewardship and enjoyment of natural, cultural and outdoor recreational resources, and insures the safety of Virginia's dams.

Fulfilling the mission….

DCR's Seven Program Divisions

Each Division offers program elements that when integrated create a comprehensive conservation and recreation agency.

- State Parks
- Soil and Water
- Dam Safety
- Chesapeake Bay Local Assistance
- Planning and Recreational Resources
- Land Conservation
- Natural Heritage

Division of Natural Heritage

- Mission: Identify, protect & conserve Virginia's biological diversity
- Focus on:
  - Rare plants and animals
  - Natural communities
- 31 Years of methodological development, 20 years of data collection and analysis
- Manage 49 Natural Area Preserves

DCR

Land Conservation

- How do we set priorities for land conservation?
  - ❖Operate under the idea of “Green Infrastructure” defined as:
    - ➢ an interconnected network of protected land and water that sustains air and water resources, maintains natural ecological processes, supports native species, and contributes to the health and quality of life for the people in our communities.
    - ➢“…it looks at conservation values and actions in concert with land development and growth management”

Healthy ecosystems provide free “services” to human communities, including: water filtration, groundwater recharging, stormwater control, air purification, nutrient recycling, crop pollination, and soil enrichment.

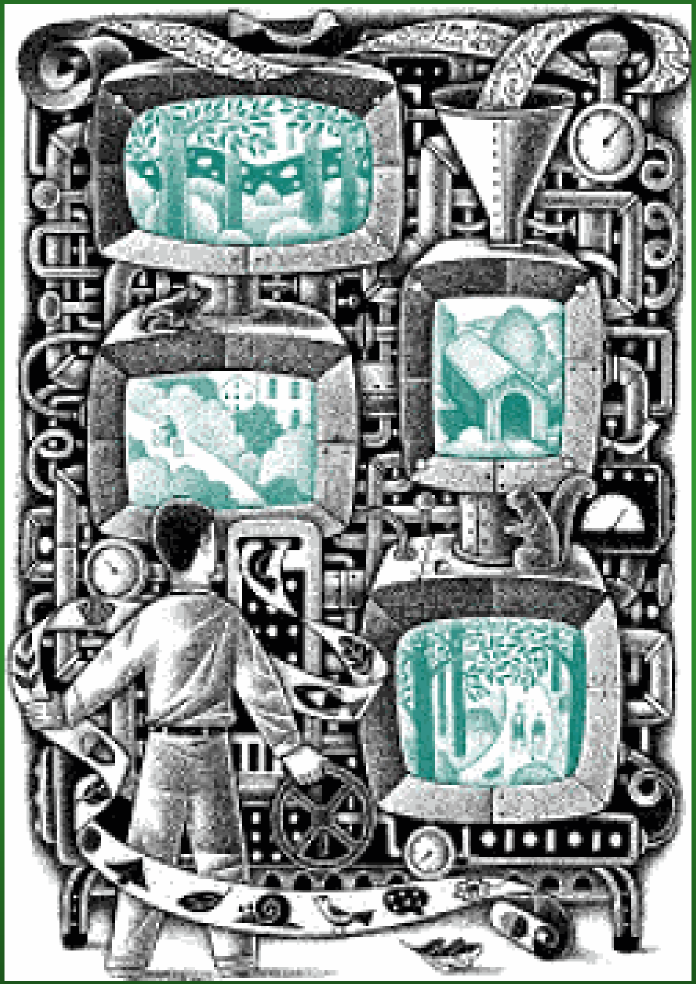
Green Infrastructure Planning

Communities don't build transportation networks or water and sewer infrastructure without advanced planning and coordination.

- ❖ These "grey" infrastructure systems are carefully designed and financed to ensure their utility.
- ❖ We should plan and invest in our Green Infrastructure following the same principles and approaches used for grey infrastructure.

How do we develop a Green Infrastructure Plan?

- Use Chesapeake Bay Program Resource Lands Assessment as a model template for the creation of Virginia specific models
- Develop a Green Infrastructure Advisory Workgroup
- Identify high level goals for the individual models
- Identify potential partners
- Research, research, research
- Develop, review, alter as needed, develop, review, alter as needed
- Implementation plans



Green Infrastructure Advisory Workgroup

- Participants included identified end users:
  - Federal
  - State
  - Local Government
  - Non-Profit Groups
  - Academia
- Green Infrastructure Advisory Workgroup:
  - Define what green infrastructure means to the different end users
  - Identify "green infrastructure" datasets (as related to their specific definitions) and identify sources (Coastal GEMS)
  - User input on how the VCLNA will be used for decision making
  - Identify products / deliverables that will be most useful for end user to implement green infrastructure planning

Green Infrastructure Advisory Committee

Federal Agenices
USFWS
USGS
NPS
Chesapeake Bay Program

State Agencies
DGIF
DOF
DCR/CBLA
VEDP
VDOT
VOF
Dept of Ag
DEQ Coastal Program

Universities
VCU
VA Tech
VIMS
W&M CCB

PDC
HRPDC
MPPDC
NVPDC
Crater PDC
RRPDC
NNPDC
A-NPDC
Richmond Regional PDC

Locals
Richmond County
Stafford County
Thomas Jefferson PDC
City of Virginia Beaach

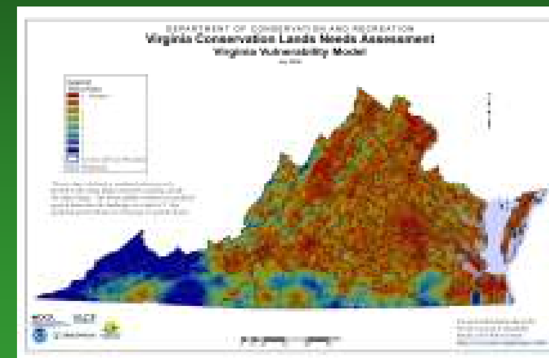
NGO's
Conservation Fund
Friends of the Dragon Run
Citizens for a Better Eastern Shore
The Nature Conservancy
The Nature Conservancy
Ches Bay Foundation
Northern Neck Land Conservancy
James River Association
Western VA Land Trust
Piedmont Env Council
VLCF
E. Shore Land Trust
Blue Ridge Conservancy

VCLNA Models

Ecological

Cultural

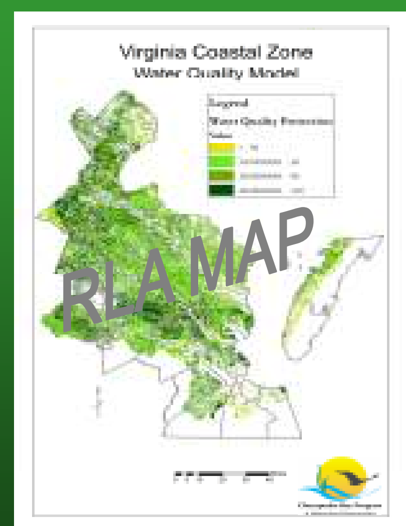
Vulnerability



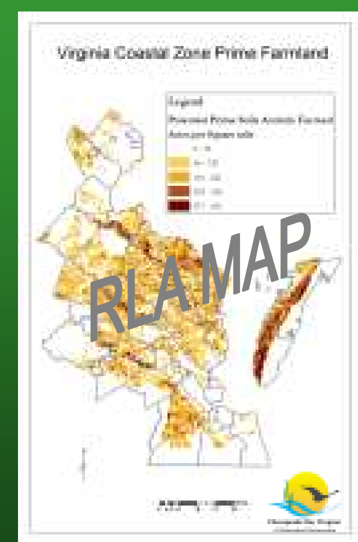
Forest Economics

Recreation

Water Quality



Agricultural



Virginia Vulnerability Model

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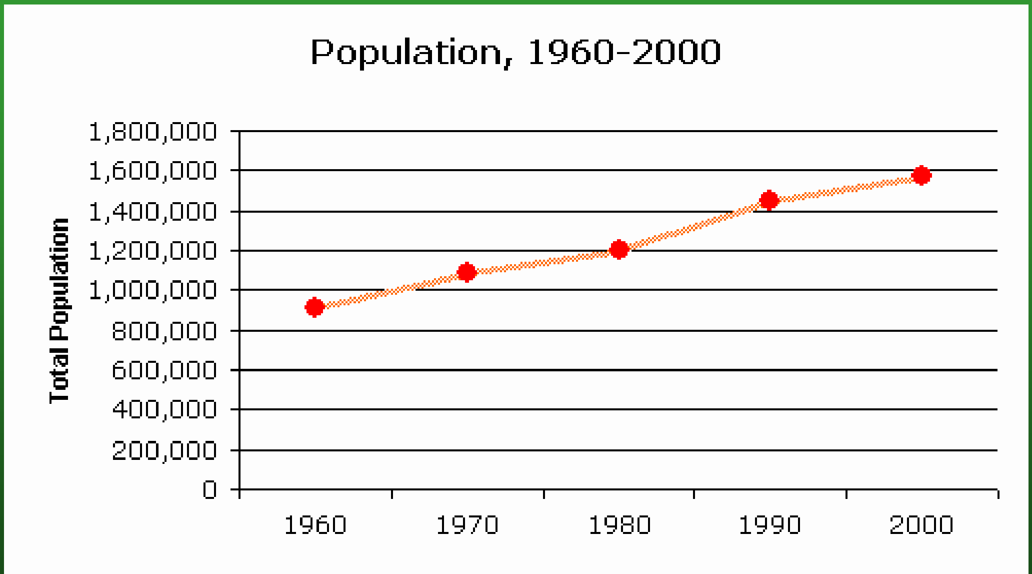
VCLNA GIS Planner
Virginia Department of Conservation and Recreation Division of Natural Heritage
Virginia Commonwealth University Center for Environmental Studies

INTRODUCTION

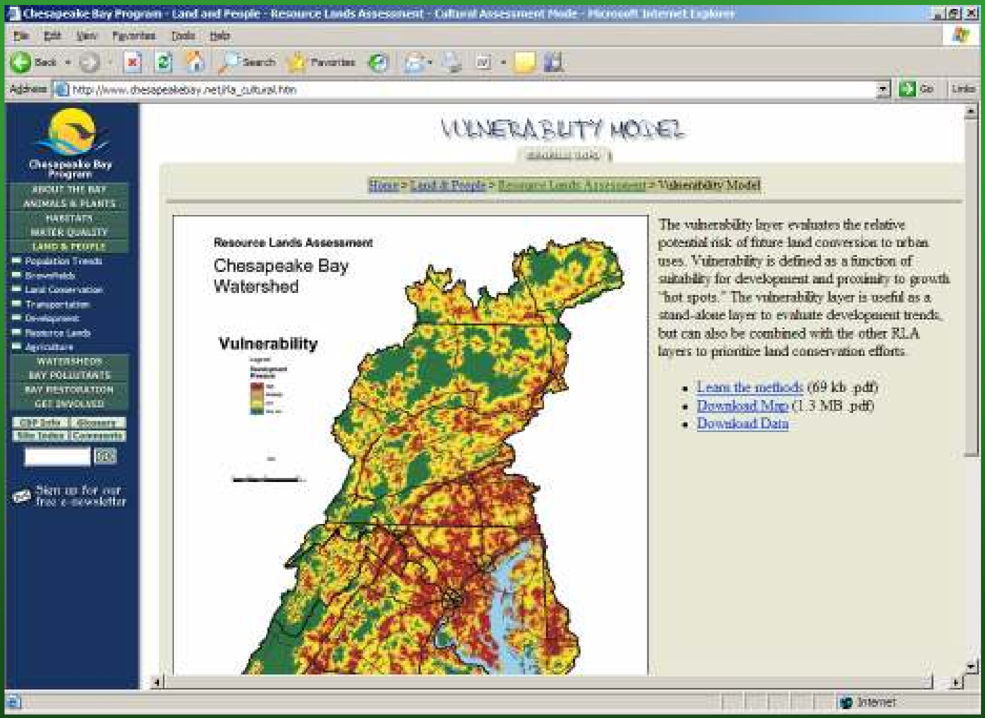
- 2000 VA population was 7,078,515 and by 2025, it is projected to be the 12th most populous state with 8.5 million *(Source: STATE POPULATION RANKINGS SUMMARY)*
- Virginia has experienced a 45% increase in imperviousness from 1990 to 2000 *(Source: Chesapeake Bay from Space Program)*

How do we put growth into context in relation to the landscape?

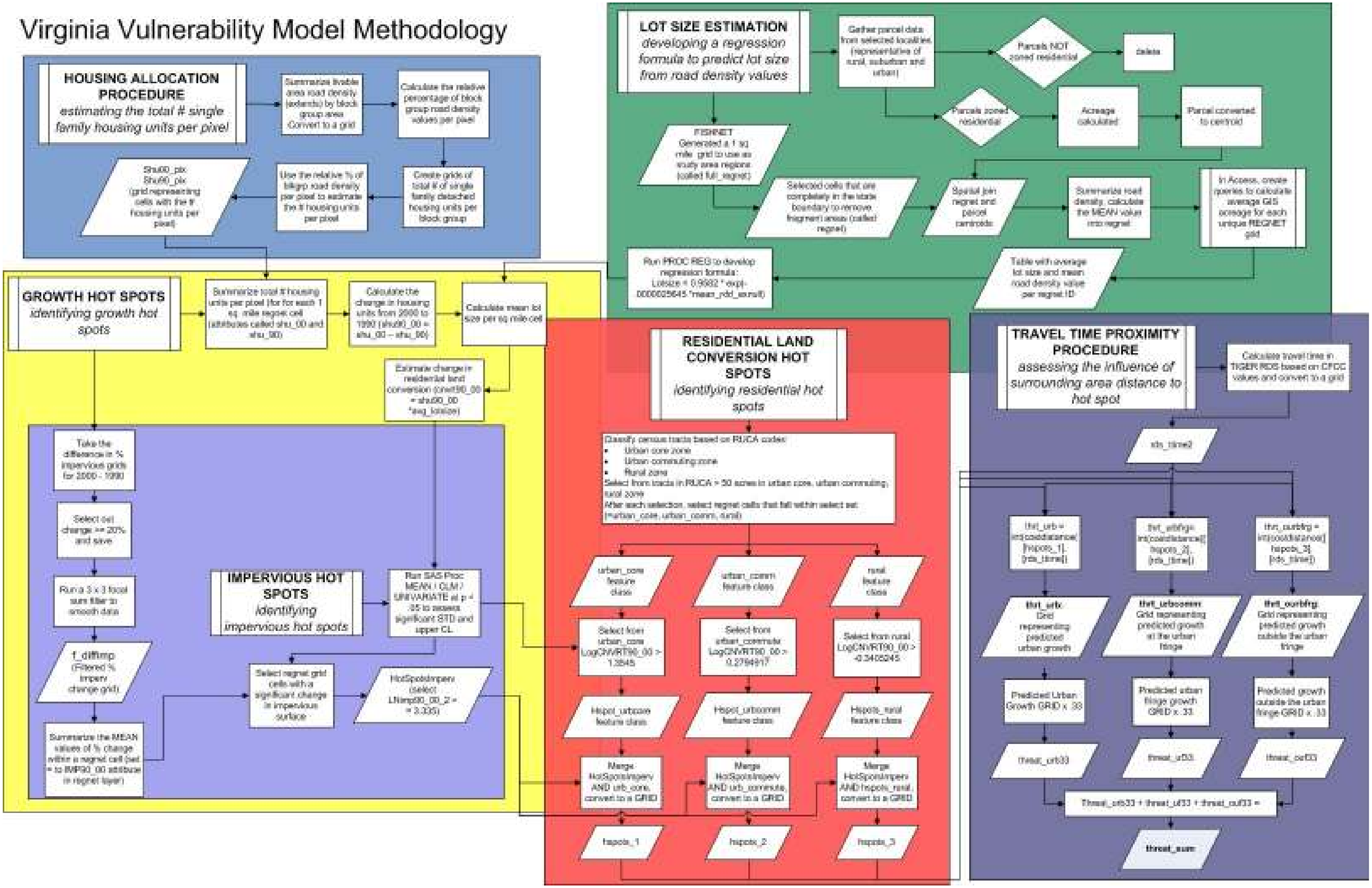


INTRODUCTION

- Vulnerability model aims to show predicted growth patterns in Virginia
- Based on the Chesapeake Bay Program's Resource Lands Assessment Vulnerability Model
- Methodology was altered to generate:
  1. Urban Vulnerability Model
  2. Urban Fringe Vulnerability Model
  3. Growth outside the Urban Fringe Vulnerability Model
  4. Virginia Vulnerability Model (inclusive of urban, suburban and rural growth)

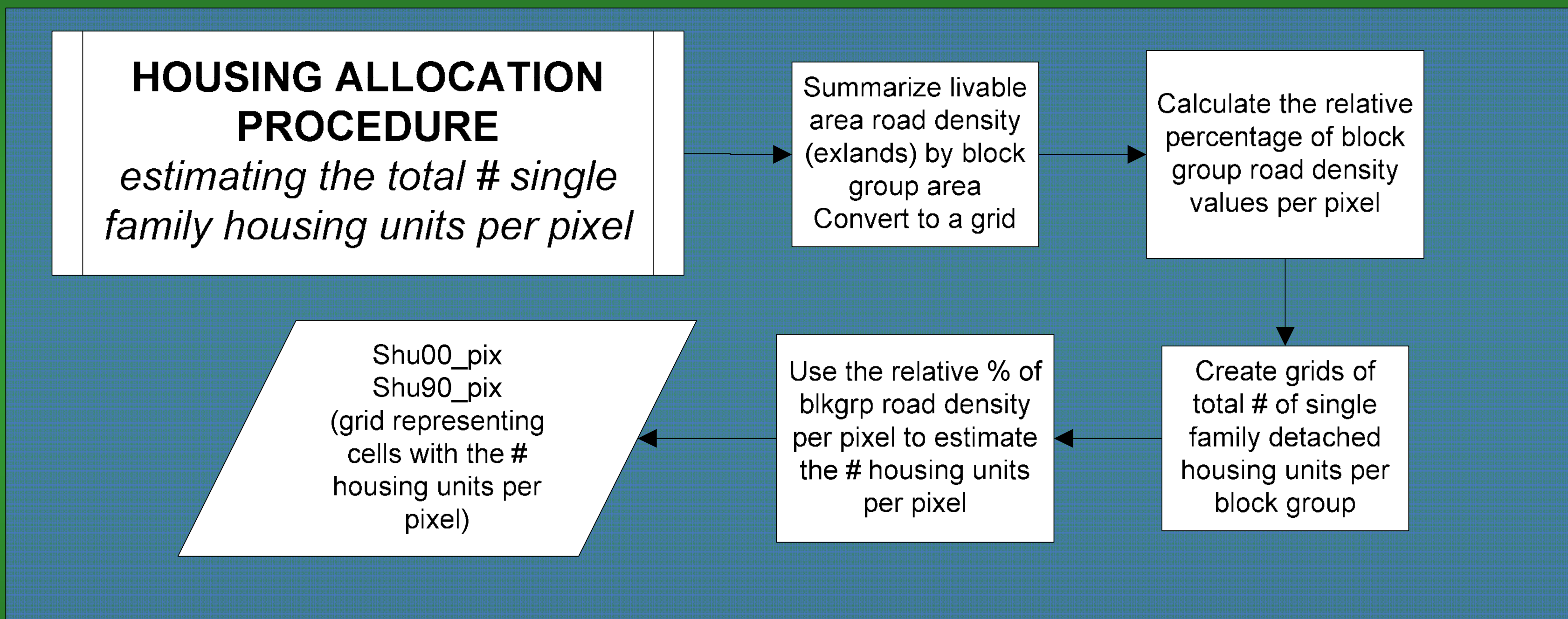


Virginia Vulnerability Model Methodology



METHODS: HOUSING ALLOCATION PROCEDURE

Estimating the total number of single family housing units per pixel



METHODS: HOUSING ALLOCATION PROCEDURE

Estimating the total number of single family housing units per pixel

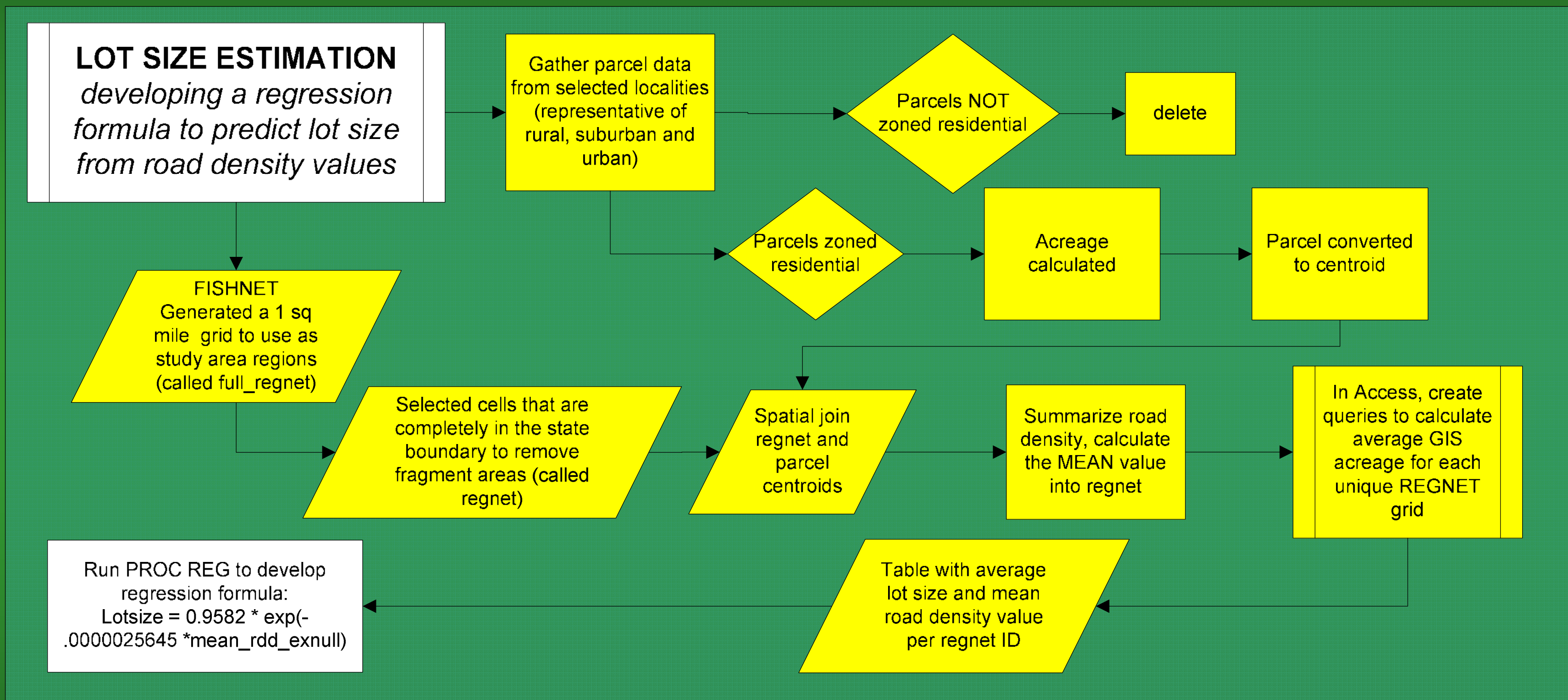
Generate a grid showing livable area road density values

- Grid showing where people would chose to live:
  - Non-livable areas are set as open water, emergent wetlands, transportation and extractive.
- Calculate what the road density is in those livable areas:

Housing Allocation

- Summarize livable area road density grid by unique block group for 1990 and 2000 census block groups.
- Calculate relative percentage of block group road density per pixel
- Calculate single family detached housing units per pixel grid (grid representing proportional # of housing units per pixel).

METHODS: LOT SIZE ESTIMATION

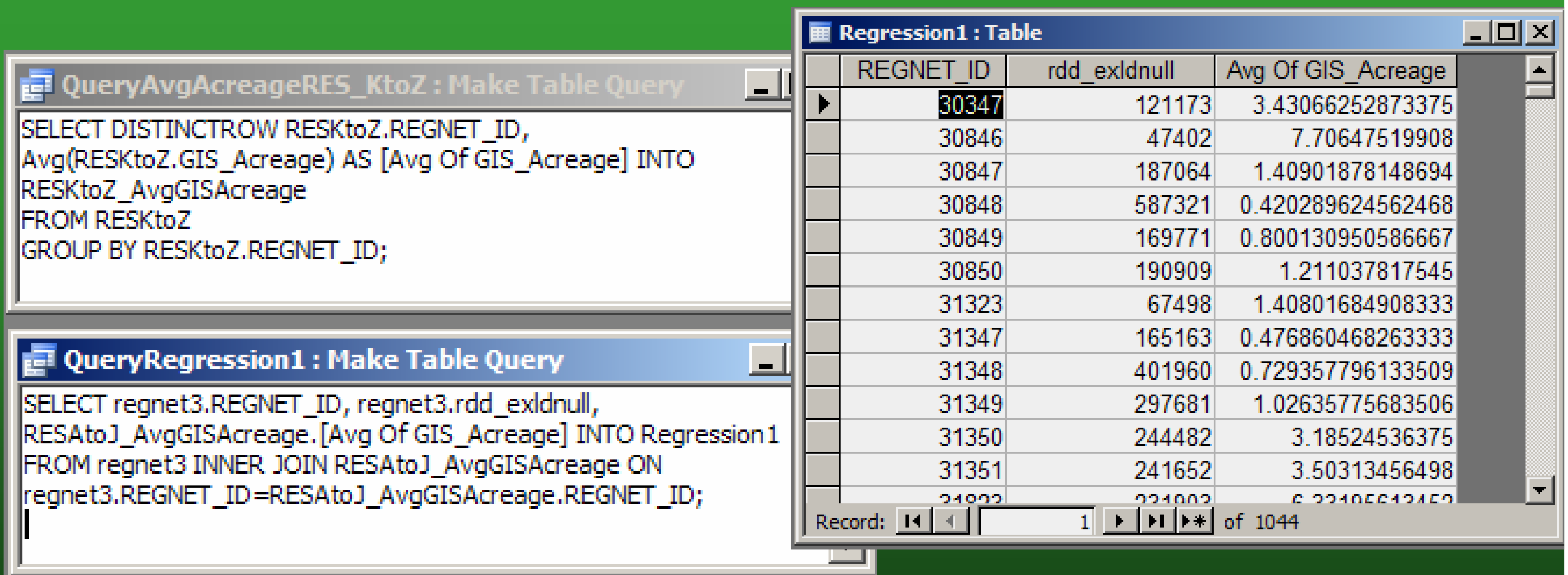


METHODS: LOT SIZE ESTIMATION

- Develop of a regression model to predict average lot size from road density values to determine land consumption rates:
- Used a 1-square mile grid as the effective planning unit (called REGNET).
- Contact Virginia localities representing urban, suburban and rural areas for GIS parcel information
  - Parcels not zoned residential as determined by the Municode or Zoning Ordinance deleted. Parcels zoned residential:
    - Acreage calculated
    - Convert to a centroid
    - Merged into one feature class
    - Assign each centroid the Unique ID of the REGNET grid it falls within (spatial join) called REGNET_ID.

METHODS: LOT SIZE ESTIMATION

- Develop of a regression model to predict average lot size from road density values to determine land consumption rates:
  - Compile results through Access queries to run regressions.



QueryAvgAcreageRES_KtoZ : Make Table Query

```
SELECT DISTINCTROW RESKtoZ.REGNET_ID,
Avg(RESKtoZ.GIS_Acreage) AS [Avg Of GIS_Acreage] INTO
RESKtoZ_AvgGISAcreage
FROM RESKtoZ
GROUP BY RESKtoZ.REGNET_ID;
```

QueryRegression1 : Make Table Query

```
SELECT regnet3.REGNET_ID, regnet3.rdd_exldnull,
RESAtoJ_AvgGISAcreage.[Avg Of GIS_Acreage] INTO Regression1
FROM regnet3 INNER JOIN RESAtoJ_AvgGISAcreage ON
regnet3.REGNET_ID=RESAtoJ_AvgGISAcreage.REGNET_ID;
```

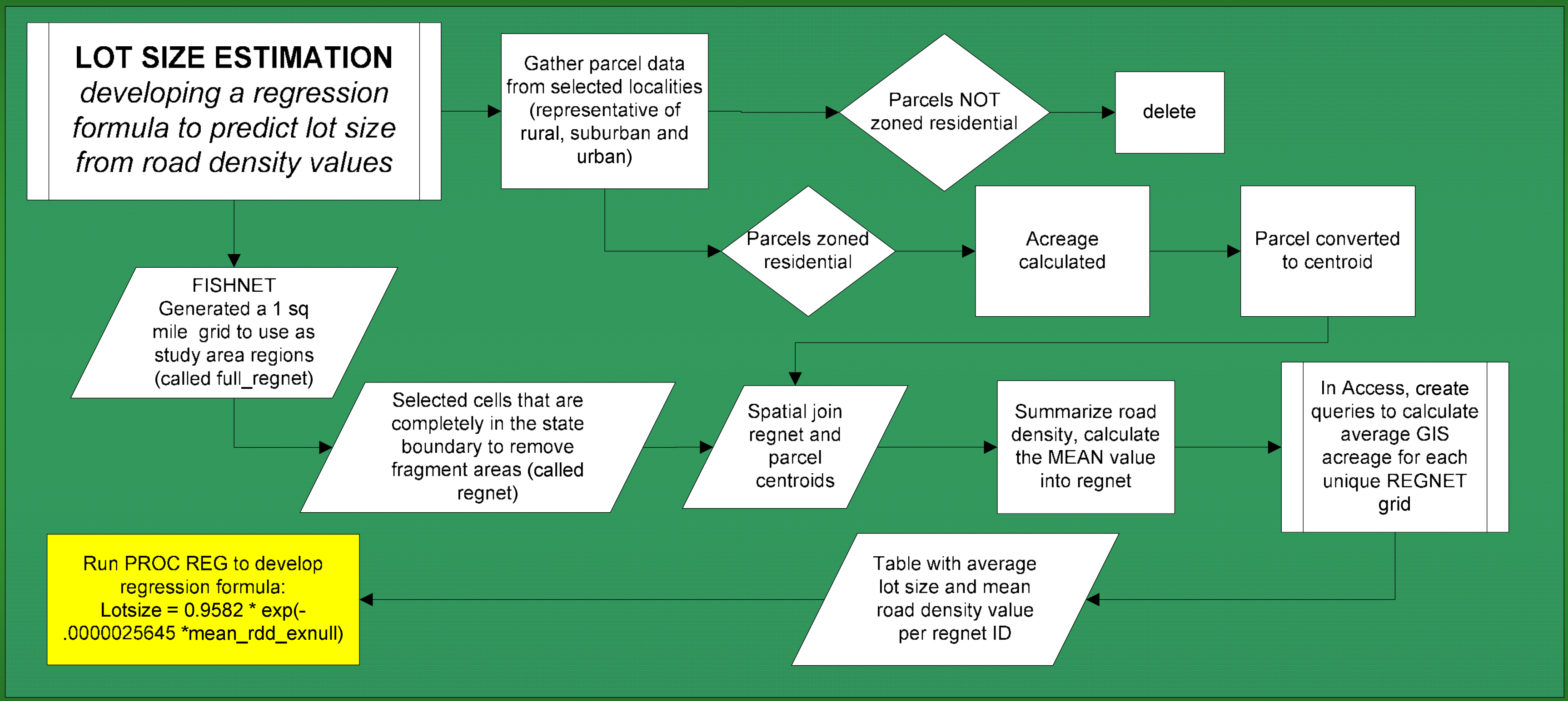
Regression1 : Table

REGNET_ID	rdd_exldnull	Avg Of GIS_Acreage
30347	121173	3.43066252873375
30846	47402	7.70647519908
30847	187064	1.40901878148694
30848	587321	0.420289624562468
30849	169771	0.800130950586667
30850	190909	1.211037817545
31323	67498	1.40801684908333
31347	165163	0.476860468263333
31348	401960	0.729357796133509
31349	297681	1.02635775683506
31350	244482	3.18524536375
31351	241652	3.50313456498

Record: 1 of 1044

METHODS: LOT SIZE ESTIMATION

Regression analyses



METHODS: LOT SIZE ESTIMATION

Regression analyses

SAS System 9.x

- Univariate statistics and plotted residuals to test for normalcy.
- Natural Log transform the average road density data. Tested again for normalcy.
- Ran regression analyses (PROC REG) to derive regression equation:

  average lot size = 0.9582e -0.0000025645(RDD_exnull)

  r-square = 0.5557, p-value < .0001

Why is this important?

To get a formula to derive a land consumption rate….

METHODS: IDENTIFICATION OF HOT SPOTS

Identifying areas considered to be hot spots for population growth.

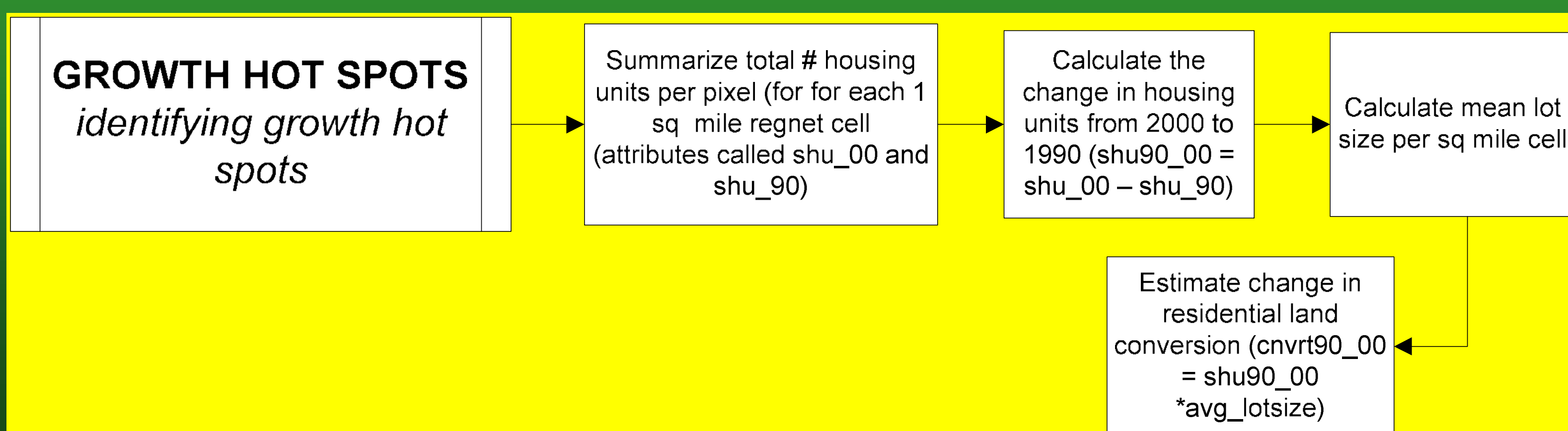
Derive land consumption values based on change in housing units from 1990 to 2000

- Summarize the single-family detached housing units per pixel within each unique planning unti (REGNET_ID (called shu_90 and shu_00)).
- Calculate the change in housing units from 1990 to 2000

  shu_00 – shu_90 = shu90_00
- Calculate the average lot size using the derived regression formula:

  MeanLotSize = 0.9582 * exp [-0.0000025645*(RDD_exnull)]
- Calculate the change in land consumption rate:

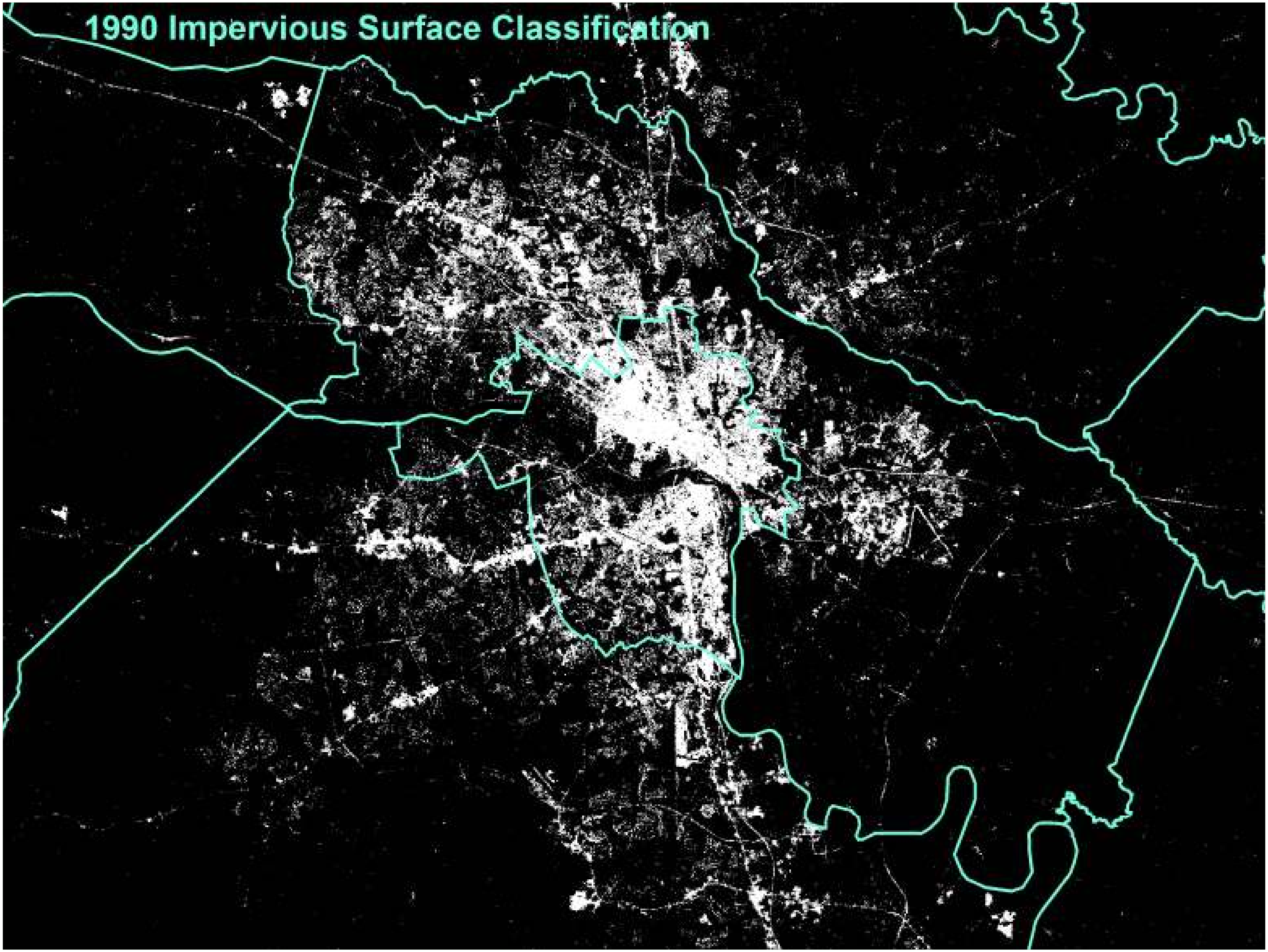
  CNVRT90_00 = shu90_00 * MeanLotSize
- Normalize the data (select where CNVRT90_00 > 0, called LogCNVRT90_00).

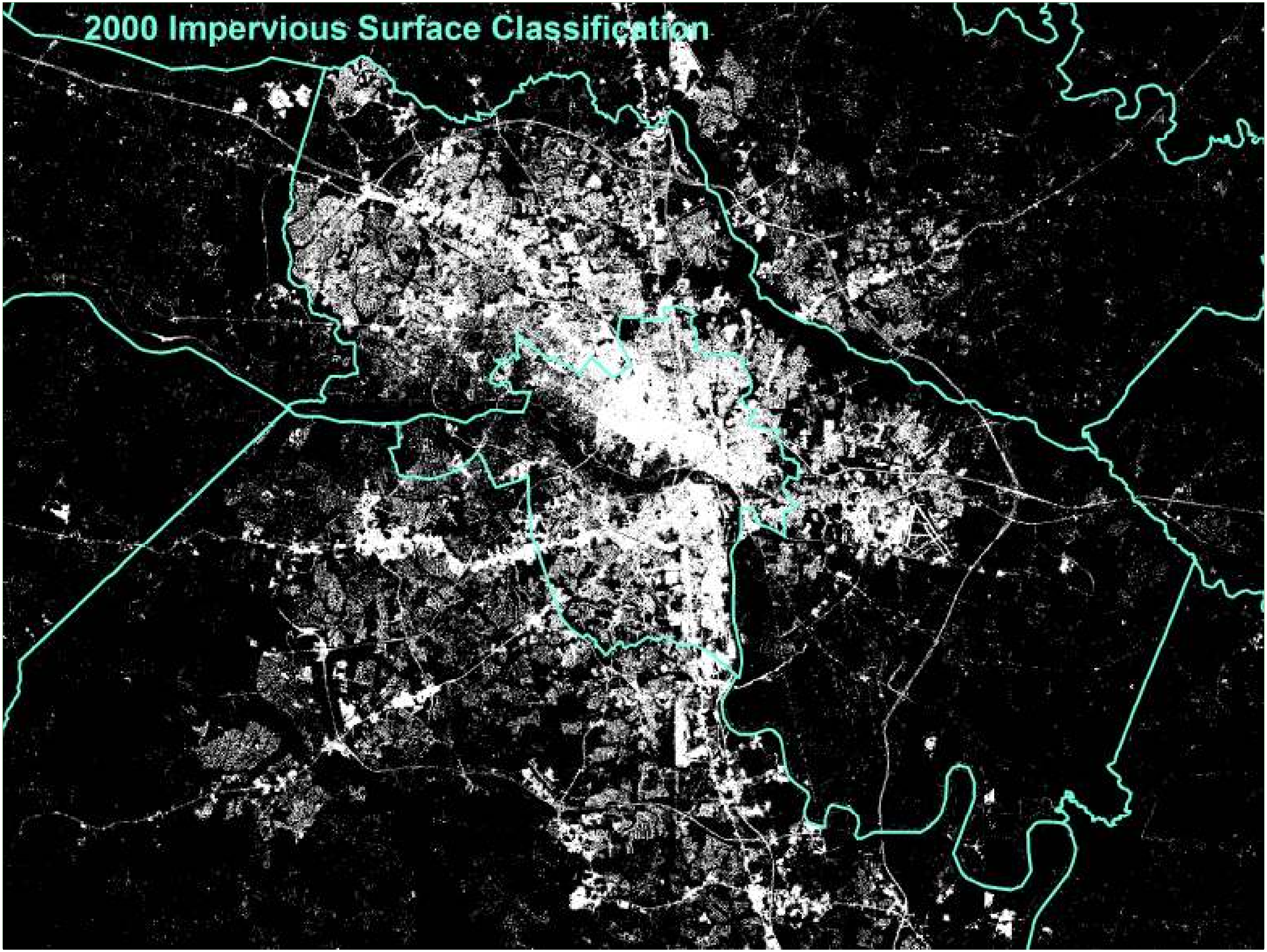


METHODS: IDENTIFICATION OF HOT SPOTS

Change in Impervious Surfaces from 1990 to 2000

- Calculate the change in impervious surfaces from 1990 to 2000 by subtracting a 1990 impervious surface grid from a 2000 impervious surface grid (pixel value represents % impervious)
- Select pixels where change in value is considered to be at least 20% (“to minimize false positive detections”) (P. R. Claggett and C. Bisland 2004)
- Summarize the change in imperviousness within each unique planning unit.
  - Calculate MEAN into imp90_00_2 attribute in planning unit grid.

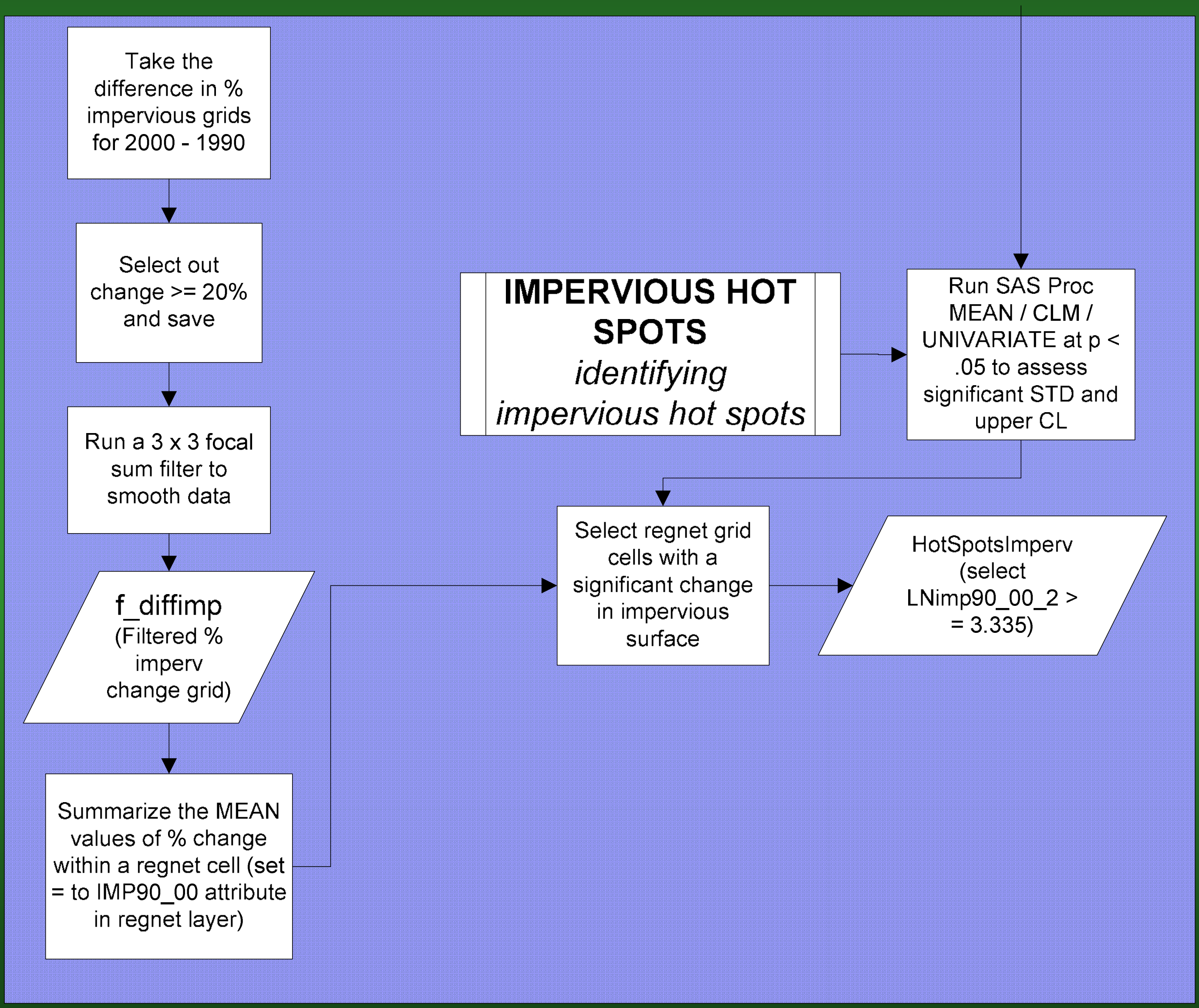

1990 Impervious Surface Classification


2000 Impervious Surface Classification

METHODS: IDENTIFICATION OF HOT SPOTS

Impervious Hot Spots

Identifying areas considered to represent significant impervious growth.



METHODS: IDENTIFICATION OF HOT SPOTS

Impervious Hot Spots

Identifying areas considered to represent significant impervious growth.

- Normalize the change in impervious surface data (called LNIMP90_00_2).
- Ran SAS PROC to find statistically significant hotspot values (the Upper Confidence Limit = 3.335)
- Exported planning units considered to be impervious hot spots:
  - LNimp90_00_2 >= 3.335
  - Export as **hspotsimp**

METHODS: RESIDENTIAL LAND CONVERSION HOT SPOTS

Identifying areas considered to represent significant changes in residential land conversion / land consumption.

- Classify census tracts with RUCA codes per RLA:

Grow Zone	Reclassified category	Original RUCA
"1"	Urban Core Zone =	Metropolitan-area cores (1.0, 1.1)
"2"	Urban Commuting Zone =	Metropolitan-area high commuting (2.x), Metropolitan-area low commuting (3.x), and all secondary flows to Urban Areas (ranging from 5 – 50%).
"3" or "4"	Rural Zone =	All other (encompassing Large town, Small town, and Rural areas lacking secondary flow to Urban Area).

Select out Urban, Suburban and Rural area hotspots:

- Select all RUCA polygons where grow zone = 1 and acres > 50. Select the planning units that have their center in the selected RUCA polygons. Export as Urban_Core.
- Select all RUCA polygons where grow zone = 2 and acres > 50. Select the planning units that have their center in the selected RUCA polygons. Export as Urban_ Commute.
- Select all RUCA polygons where grow zone = 3 and acres > 50. Select the planning units that have their center in the selected RUCA polygons. Export as Rural.

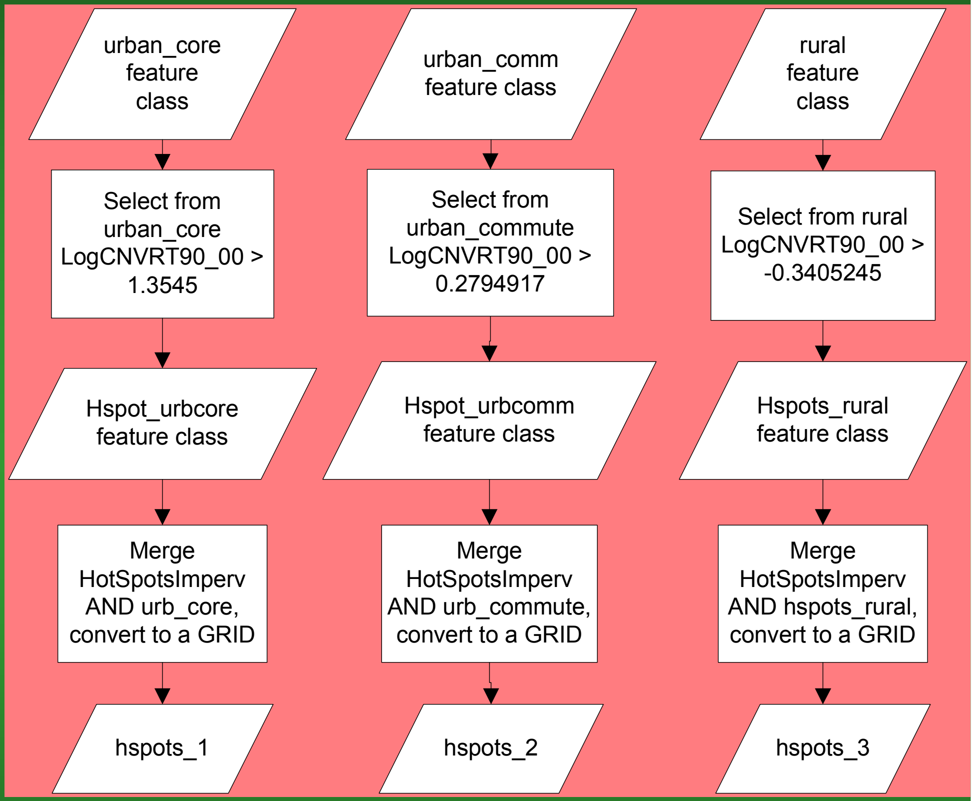
RESIDENTIAL LAND CONVERSION HOT SPOTS
identifying residential hot spots

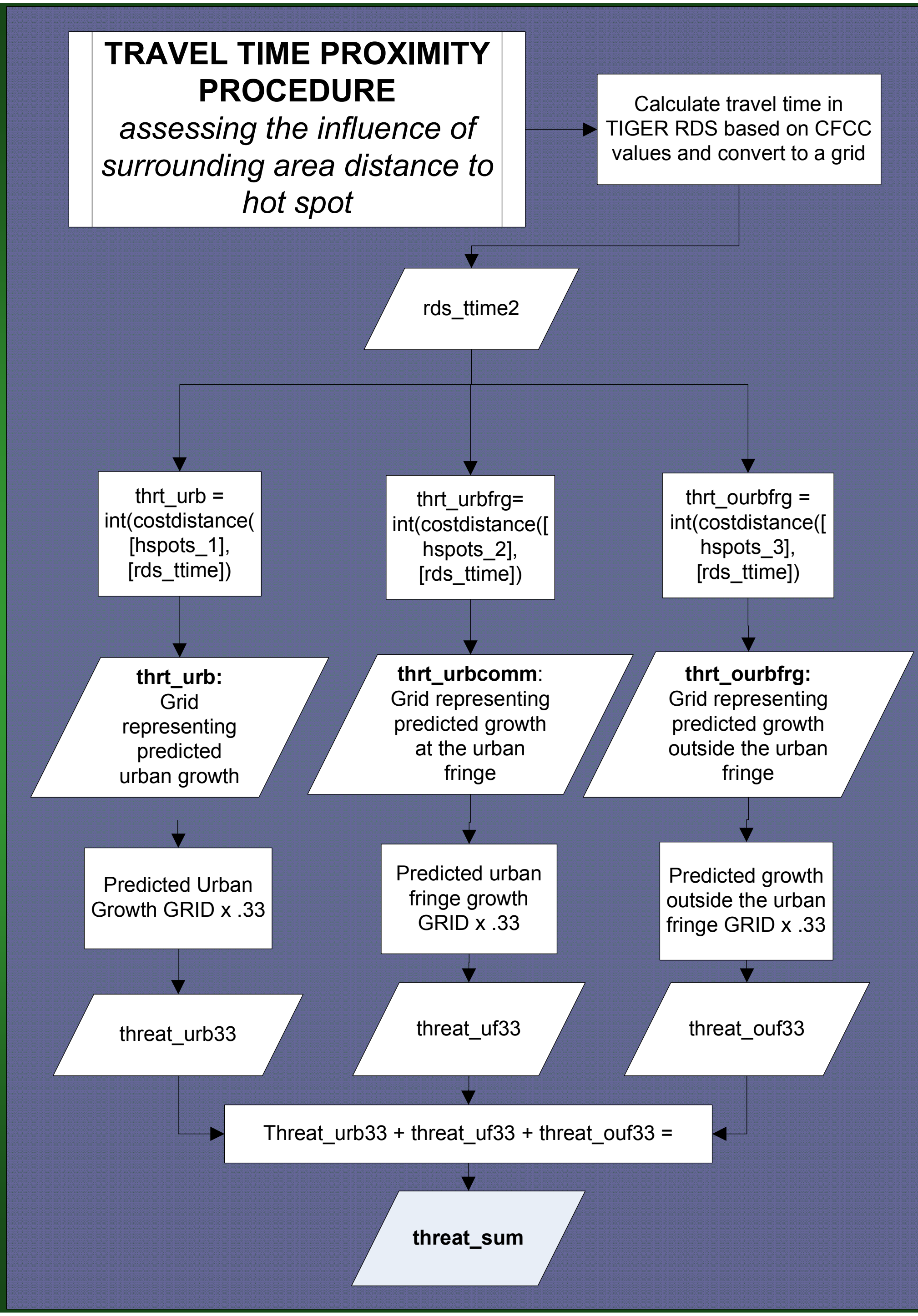
Classify census tracts based on RUCA codes:
- Urban core zone
- Urban commuting zone
- Rural zone

Select from tracts in RUCA > 50 acres in urban core, urban commuting, rural zone
After each selection, select regnet cells that fall within select set (=urban_core, urban_comm, rural)

METHODS: RESIDENTIAL LAND CONVERSION HOT SPOTS

- In SAS, calculate the significant value to identify residential hotspots for urban, urban commute and rural ($p < .05$, SE = 1.64).
- Use the values to select out from:
  - Urban_Core >=1.3545. Export as hspots_core (representing urban hotspots).
  - Urban_Commute >= 0.2795. Export as hspots_commute (representing suburban hotspots).
  - Rural >= -0.3405. Export as hspots_rural (representing rural hotspots).
- Merge impervious surface hotspots with each to generate 3 grids called:
  - Hspots_1
  - Hspots_2
  - Hspots_3




TRAVEL TIME PROXIMITY PROCEDURE
assessing the influence of surrounding area distance to hot spot
Calculate travel time in TIGER RDS based on CFCC values and convert to a grid
rds_ttime2
thrt_urb = int(costdistance([hspots_1], [rds_ttime])
thrt_urbfrg= int(costdistance([hspots_2], [rds_ttime])
thrt_ourbfrg = int(costdistance([hspots_3], [rds_ttime])
thrt_urb: Grid representing predicted urban growth
thrt_urbcomm: Grid representing predicted growth at the urban fringe
thrt_ourbfrg: Grid representing predicted growth outside the urban fringe
Predicted Urban Growth GRID x .33
Predicted urban fringe growth GRID x .33
Predicted growth outside the urban fringe GRID x .33
threat_urb33
threat_uf33
threat_ouf33
Threat_urb33 + threat_uf33 + threat_ouf33 =
threat_sum

METHODS: THREAT GRIDS

Travel Time

Creating a travel time grid to incorporate the influence of distance to hot spots on surrounding areas.

- Downloaded Tiger RDS and attributed with travel time:

CFCC	Description	MPH	TTIME
A1	Primary highway with limited access (e.g., Interstates)	65	57
A2	Primary road without limited access (mainly US Highways)	55	68
A3	Secondary and connecting roads (e.g., State and County highways)	40	93
A4	Local, neighborhood, and rural roads	30	124
A6	Road with special characteristics (ramps, traffic circles, etc.)	15	249
Other A5x's and A7x's (off-road trails, driveways, alleys, etc.)		5	746

- Calculate the urban growth threat grid based on travel time to nearest hot spot:

    Grid: |> threat_1 = int(costdistance(hspots_1, rds_ttime2)) <|

- Calculate urban fringe / metropolitan fringe growth threat based on travel time:

    Grid: |> threat_2 = int(costdistance(hspots_2, rds_ttime2)) <|

- Calculate outside the urban fringe growth threat based on travel time:

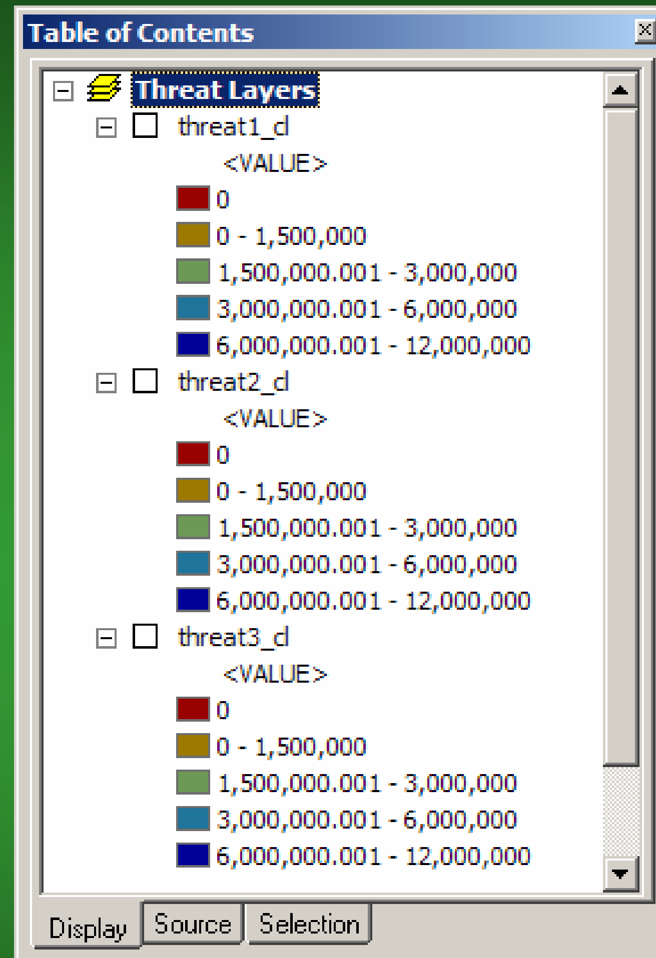
    Grid: |> threat_3 = int(costdistance(hspots_3, rds_ttime2)) <|

METHODS: THREAT GRIDS

- Display threat_1 (urban growth threat), threat_2 (urban fringe growth) and urban_3 (outside the urban fringe growth) with 5 manual breaks in ArcMap, with a higher threat value indicates a great threat:

THREAT	GRID VALUE	TRAVEL TIME (minutes)
5	0	0
4	0.001 - 1,500,000	0 to 15
3	1,500,000.001 - 3,000,000	15 to 30
2	3,000,000.001 - 6,000,000	30 to 60
1	6,000,000.001 - 12,000,000	60 to 120

- Set threat grid values to THREAT
- Convert grids to a shapefile.
- Generate metadata in ArcCatalog.
- Convert shapefile to geodatabase feature classes.

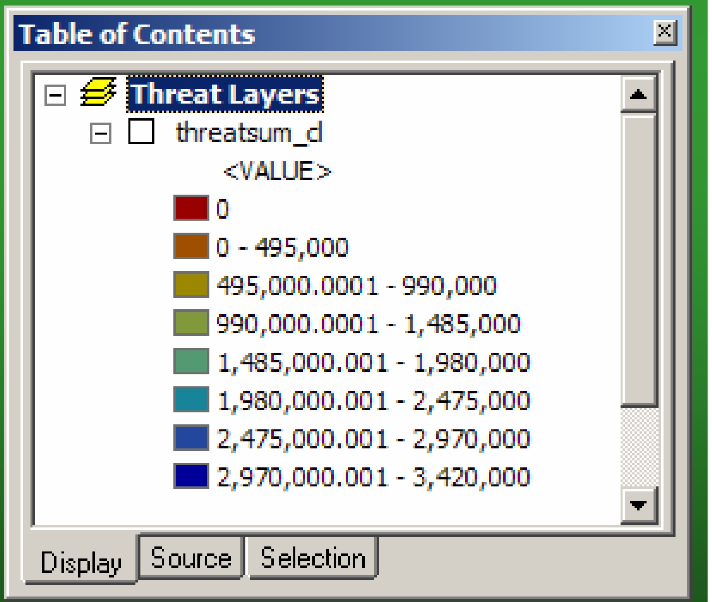


METHODS: THREAT GRIDS

Summed Vulnerability Grid

- Multiply each grid by .33 to get a proportional value of threat / travel time
- Sum proportional threat layers together = threat_sum grid
- Display threat_sum (compiled threat model showing predicted growth in the urban, urban fringe and outside the urban fringe areas with 8 manual breaks in ArcMap (higher threat value indicates a greater growth threat)):

THREAT	GRID VALUE	TRAVEL TIME (approx minutes)
8	0	0
7	0.001 - 495,000	0 to 5
6	495,000.001 - 990,000	5 to 10
5	990,000.001 - 1,485,000	10 to 15
4	1,485,000.001 - 1,980,000	15 to 20
3	1,980,000.001 - 2,475,000	20 to 25
2	2,475,000.001 - 2,970,000	25 to 30
1	2,970,000.001 - 3,420,000	30 to 35



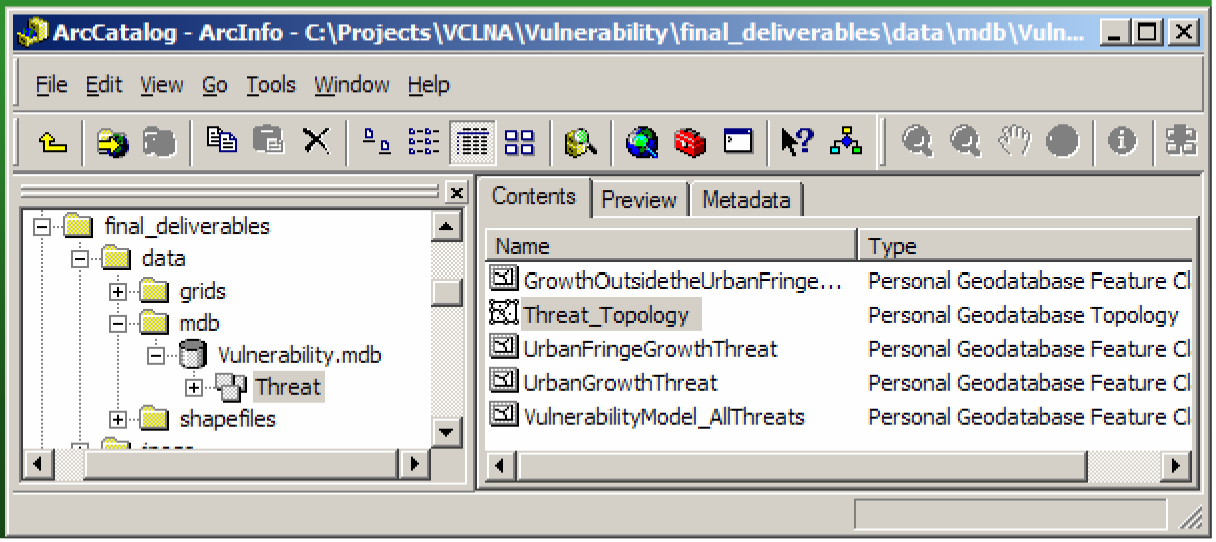
METHODS: VALIDATION

Reality Check

- The original version of the Vulnerability Model was sent to:
  - Crater PDC
  - Hampton Roads PDC
  - Goochland County
  - Middle Peninsula PDC
  - Northern Neck PDC
  - Thomas Jefferson PDC
- Comments indicated the model was misrepresenting hotspots.
- The model was re-run with statistical analyses
- Four models were developed to account for urban, suburban and rural growth pressures.
- Final model passed through an internal review at the Division of Natural Heritage.
- The VCLNA website will be equipped to receive comments

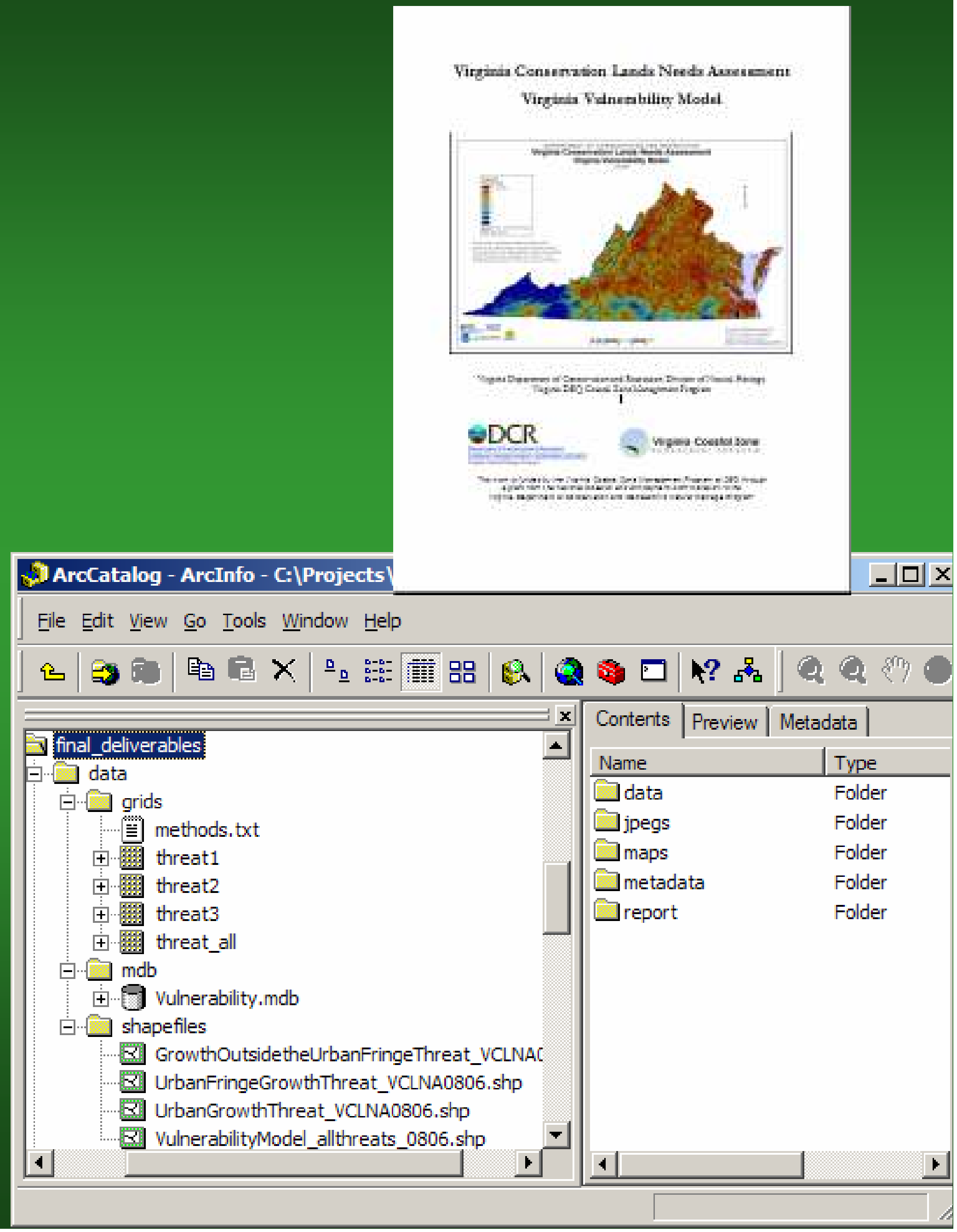
Topological Validation:

- Created a topology for each threat feature class with rules:
  - Must Not Overlap
  - Must Not Have Gaps
- Validated topology.



DELIVERABLES

- Geodatabase / GRIDS /shapefiles of:
  - ❖ Urban Vulnerability Model
  - ❖ Urban Fringe Vulnerability Model
  - ❖ Growth outside the Urban Fringe Vulnerability Model
  - ❖ Virginia Vulnerability Model (inclusive of urban, suburban and rural growth)
- Metadata
- Report detailing:
  - – Methodology
  - – Incorporation of local data
  - – Deliverables

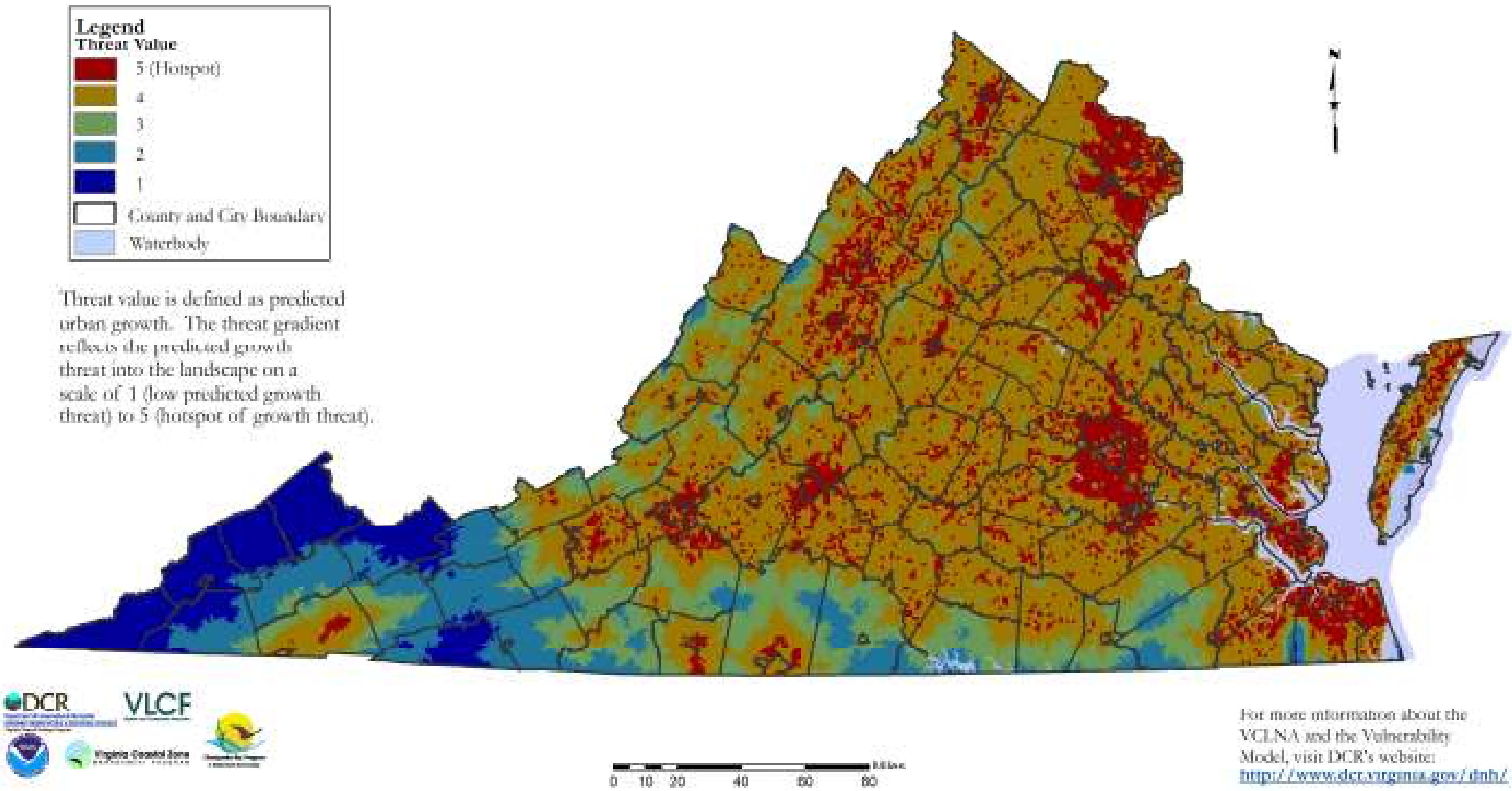


DEPARTMENT OF CONSERVATION AND RECREATION

Virginia Conservation Lands Needs Assessment

Virginia Urban Vulnerability Model

July 2006



DEPARTMENT OF CONSERVATION AND RECREATION

Virginia Conservation Lands Needs Assessment

Virginia Urban Fringe Vulnerability Model

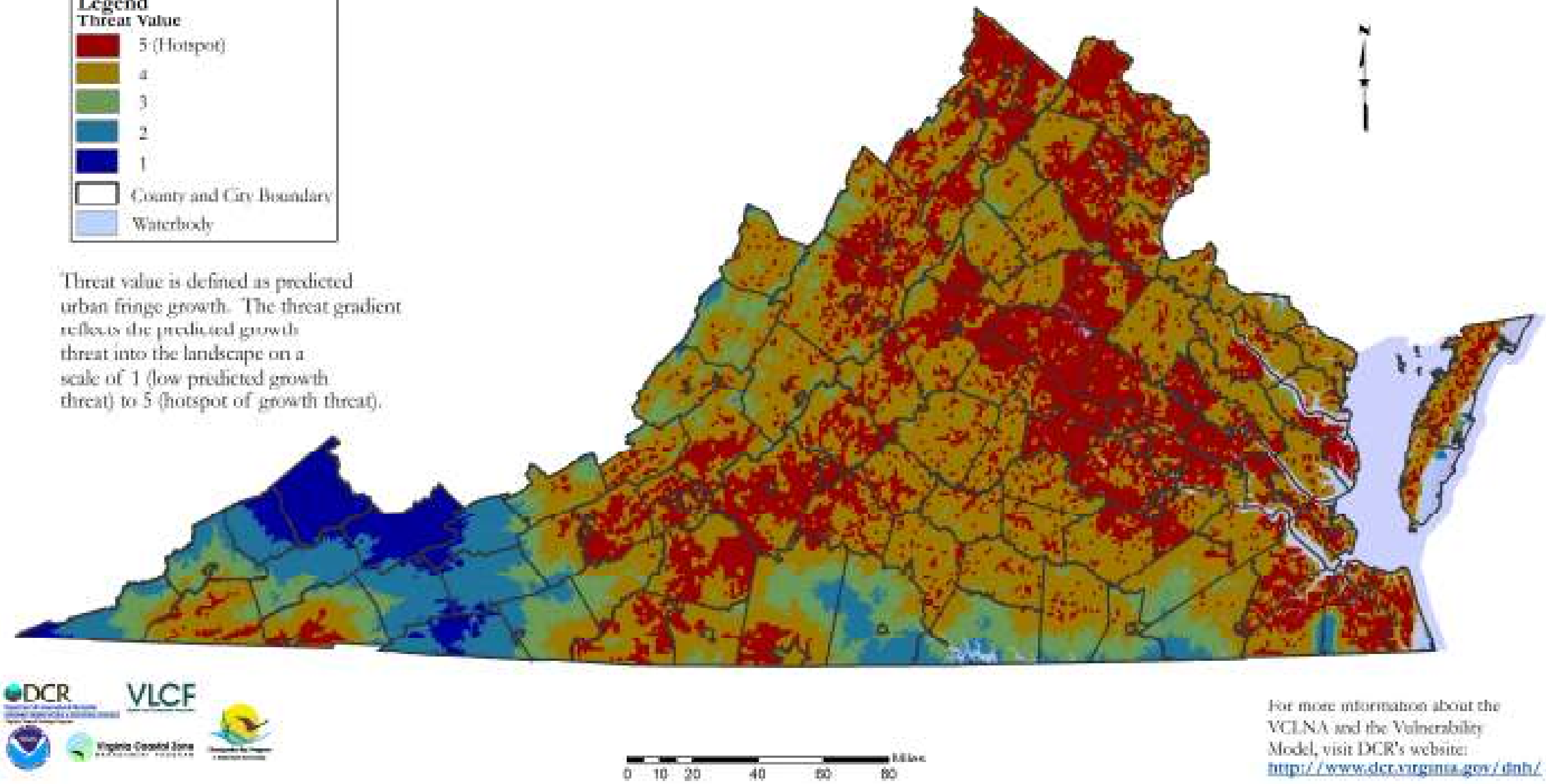
July 2006

Legend

Threat Value

- 5 (Hotspot)
- 4
- 3
- 2
- 1
- County and City Boundary
- Waterbody

Threat value is defined as predicted urban fringe growth. The threat gradient reflects the predicted growth threat into the landscape on a scale of 1 (low predicted growth threat) to 5 (hotspot of growth threat).



For more information about the VCLNA and the Vulnerability Model, visit DCR's website: http://www.dcr.virginia.gov/dnh/

DEPARTMENT OF CONSERVATION AND RECREATION

Virginia Conservation Lands Needs Assessment

Virginia Outside the Urban Fringe Vulnerability Model

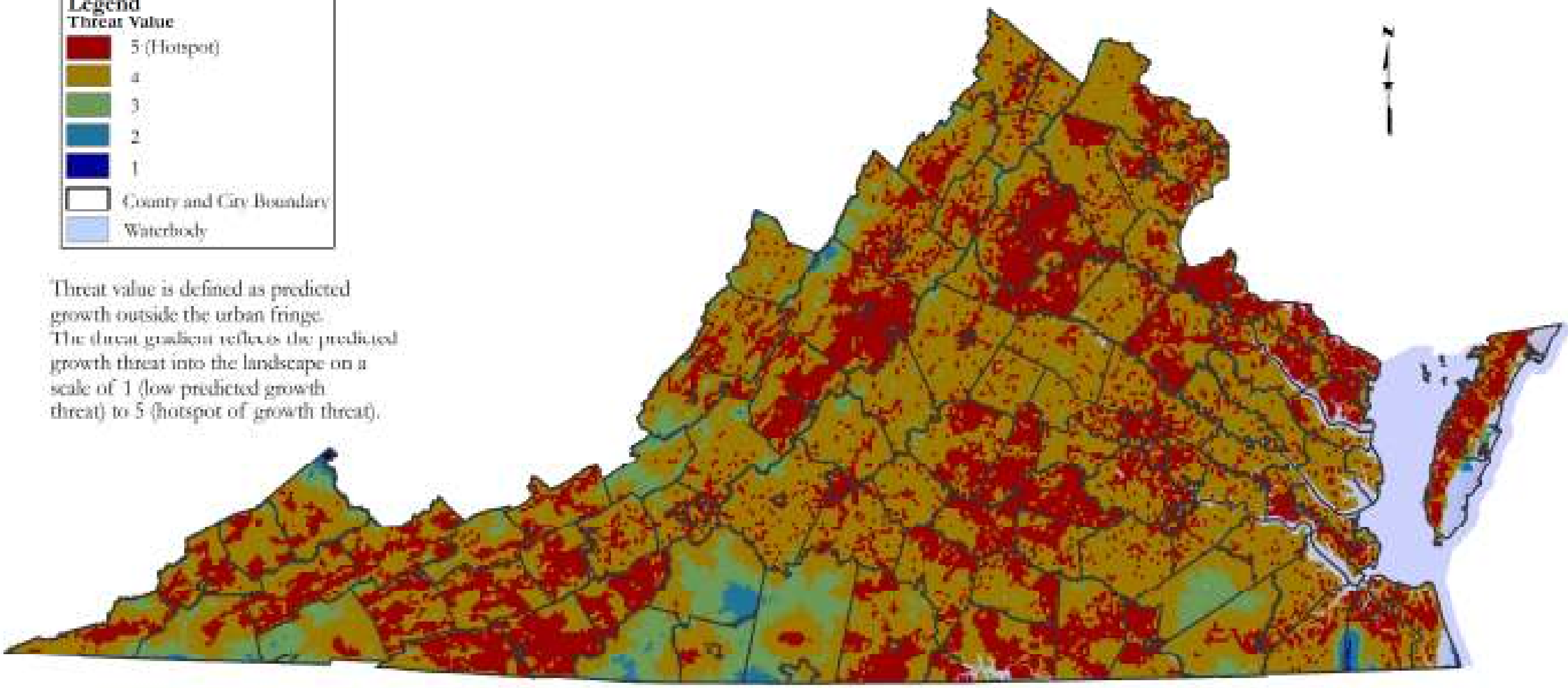
July 2006

Legend

Threat Value

- 5 (Hotspot)
- 4
- 3
- 2
- 1
- County and City Boundary
- Waterbody

Threat value is defined as predicted growth outside the urban fringe. The threat gradient reflects the predicted growth threat into the landscape on a scale of 1 (low predicted growth threat) to 5 (hotspot of growth threat).



0 10 20 40 60 80 Miles

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DEPARTMENT OF CONSERVATION AND RECREATION

Virginia Conservation Lands Needs Assessment

Virginia Vulnerability Model

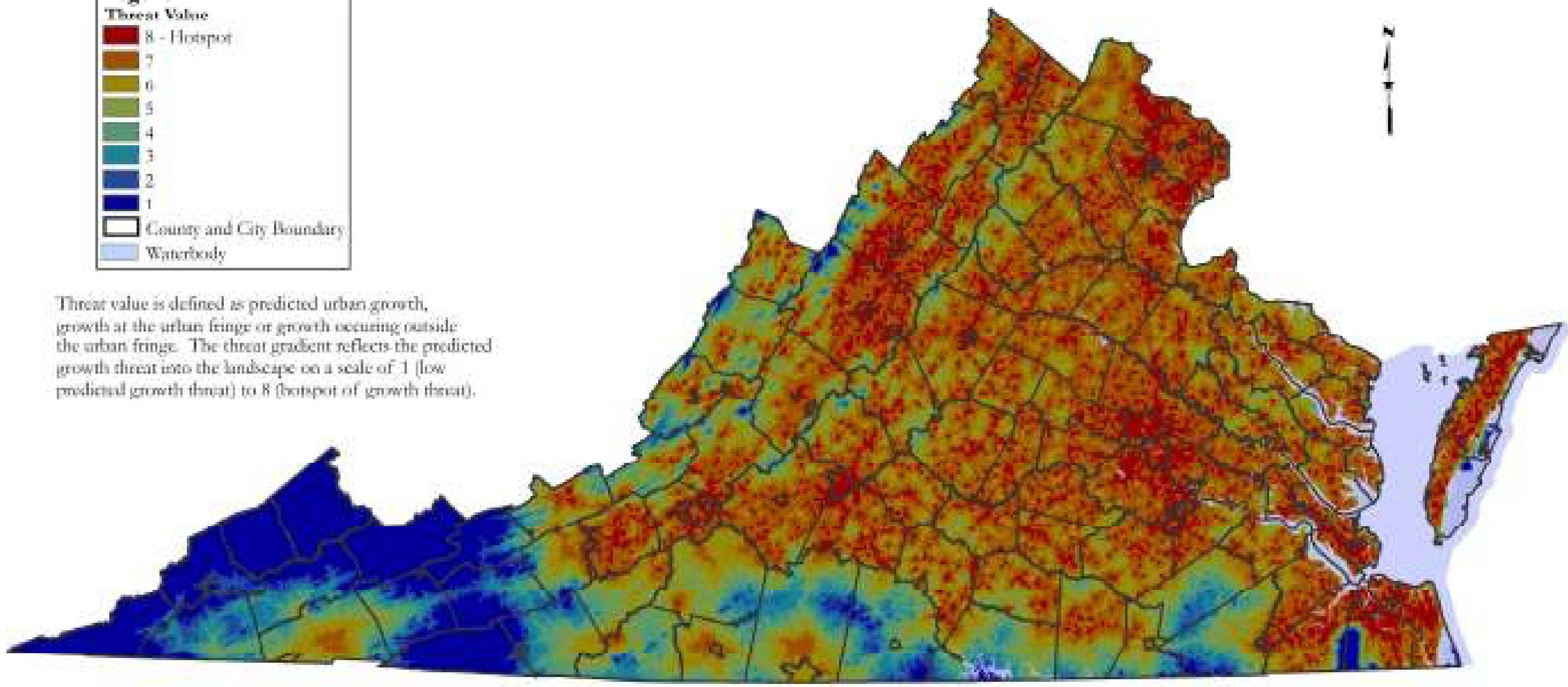
July 2006

Legend

Threat Value

- 8 - Hotspot
- 7
- 6
- 5
- 4
- 3
- 2
- 1
- County and City Boundary
- Waterbody

Threat value is defined as predicted urban growth, growth at the urban fringe or growth occuring outside the urban fringe. The threat gradient reflects the predicted growth threat into the landscape on a scale of 1 (low predicted growth threat) to 8 (hotspot of growth threat).



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Department of Conservation and Recreation Acknowledges

VLCF
Virginia Land Conservation Foundation

Virginia Coastal Zone
MANAGEMENT PROGRAM

VCU
Virginia Commonwealth University

VIRGINIA DEPARTMENT OF FORESTRY

Chesapeake Bay Program
A Watershed Partnership

NOAA

QUESTIONS?

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Visit: http://www.dcr.virginia.gov/dnh/vclna.htm